STAT

MECHANISM OF THE ACTION OF VISCOSITY-MODIFYING ADDITIVES

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The thickening action of polymers (polyisobutenes, vinipols [polyvinyls], voltols, polymethacrylates, and polyalkylstyrenes) depends on the structural characteristics of their solutions. Most frequently used are polyisobutenes with molecular weights of 15,000-25,000, which allegedly improve the viscosity-temperature characteristics of low-viscosity oils to a greater degree than those of high-viscosity oils. For an accurate estimate of the behavior of oils of different viscosities, the ratio V_{50}/V_{100} should be employed, because the index of viscosity is devoid of physical significance and cannot be used for this purpose. (V_{50}/V_{100} is the ratio of the kinematic viscosity in centistokes at 50°C to the kinematic viscosity at 100°C in the same units.)

Thickening with polyisobutene does not improve the viscosity-temperature characteristics of any oil irrespective of its original viscosity; it may even make these characteristics worse when a large quantity of polyisobutene has been added. The lower the viscosity of the initial oil at 100°C, the better are its viscosity-temperature characteristics. By using an initial oil which has the lowest possible viscosity (less than 4 centistokes at 100°C), and which furthermore has the most favorable V_{50}/V_{100} ratio, one may obtain an oil which has good properties. The thickening effect of voltols and vinipols with a molecular weight of about 9,000 has also been investigated. It appears that all relationships which have been established for the thickening action of polyisobutene are also valid in thickening with voltols and vinipols.

Contrary to statements made in the literature, the index V_{50}/V_{100} characterizes changes of the viscosity depending on the temperature not only in the range 50-100°C, but also at temperatures below zero. When this index is low, and the viscosity is also low, the oil has desirable viscosity-temperature characteristics at temperatures below zero.

In view of the fact that the ratio V/V_0 (viscosity of the thickened oil to the viscosity of the initial oil) in oil thickened with the same quantity of polymer remains constant within a wide range of temperatures and does not depend on the viscosity of the initial oil, one may conclude that the structural state of the polymers in solution does not undergo any changes within an extensive temperature range covering both positive and negative temperatures. The polymers exhibit the same viscosity-temperature dependence as the oils in which they are dissolved. During the process of solution the molecules of polymers tend to preserve [or to assume] their ordinary, unstretched state: they remain unstretched and wound up into globules in solution. The process of solution does not differ from that taking place when two oils are blended. The polymers change their viscosity with the temperature in exactly the same manner as the oils. Consequently, the viscosity-temperature characteristics of the thickened oil must be the same as those of the initial oil which has not been thickened, although the thickened oil has a higher viscosity.

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